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HEALTH CONSERVATION AT STEEL MILLS

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BY

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CONTENTS.

	Page.
Introduction	5
Medical supervision of employees	6
Permanent facilities necessary	7
Duties of medical supervisor	8
Plant hospital	9
Fatigue as a cause of occupational disability	10
Relation of industrial buildings to health of employees	11
Space allowed for each employee	11
Flooring	12
Illumination	12
Natural illumination	13
Artificial illumination	14
Intense or harmful lights	15
Goggles	16
Noise as a cause of lowered efficiency	18
Ventilation	18
Temperature and humidity	20
Hours of duty	21
Washing facilities	22
Wash and locker rooms	22
Baths	22
Washbasins	23
Lockers	24
Water-closets	24
Drinking water	25
Requirements of a drinking-water system	25
Purity	26
Adequate supply	26
Methods of distribution	26
Temperature of the water	27
Drinking-water systems for small plants	28
Restaurants	29
Cooperation between employer and employee	31
Publications on mine accidents and methods of metal mining	35

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HEALTH CONSERVATION AT STEEL MILLS.

By J. A. Watkins,
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INTRODUCTION.

The "safety first" campaign, instituted for the prevention of injury and loss of human life, was a timely movement. As a preventive measure it meets the hearty support and cooperation of all. The results that have been obtained have been of great value and benefit to the employer, the employee, his dependents, and society at large. The accomplished work is admirable and can be compared to the public health movement of the last 50 years as "a noble example of successful, philanthropic activity."

Consideration of the end toward which the movement is aiming—the saving of life and limb—clearly brings out the fact that there is a broader field into which to extend the safety propaganda. The idea should not be confined to the relatively narrow field of accident prevention alone, but should be expanded to include the prevention of all those factors that in the end produce the same result—the partial or total incapacitation of the worker. These factors have been called into being as a result of the change in the character of man's work, the conditions under which it is performed, and the amount of work necessary to self-maintenance. From an industrial standpoint these changes became particularly noticeable with the substitution of steam for water power. With this revolution began many of the industrial health hazards. The number and seriousness of occupational health hazards have increased rapidly with the evolution of new machinery, the use of new materials and processes of manufacture, and the resulting new products. The attempted or forced adaptation of the human body to this changed environment has resulted in many abnormal conditions. The importance of the prevention of disease among workers can be realized from the fact that the average loss of time due to illness among approximately 30,000,000 workers in the United States is 9 days a year. This is 270,000,000 working days or about 750,000 working years annually. If medical attention be estimated at one dollar a day and earnings at two dollars a day this loss amounts to nearly $880,000,000 annually.

Incapacitation of the worker from industrial diseases results from a series of minor accidents, which differ from ordinary industrial accidents mainly in the time element, the disability being produced insiduously instead of instantaneously. The ultimate effects are similar. Between a man dead of tuberculosis and one killed by the wheels of a massive machine, between an injured man and a sick one, the choice is small, whether he, his dependents, his employer, or society at large be regarded.

The statement that a man whose health is below par has a working efficiency below par should need no explanation. Efficiency of the workman is a subject no operator can afford to ignore, for, after all, industrial efficiency depends on the man behind the machine. Aside then from its humanitarian aspects, the prevention of conditions productive of ill health is a plain business proposition. How many men in a plant are working hard and conscientiously yet below their normal capacity because of harmful or even uncomfortable conditions? Is not the efficiency of many a man below par because of some physical defect, as, for example, an error in vision, of which no one—not even himself—is aware? How much could his efficiency be increased by correcting the defect? Can not more and better work be accomplished with the same effort by those working in pleasant and healthful surroundings than by those working under conditions conducive to undue fatigue and to disease?

"Safety first" work is now so well organized, its operation is so systematized, that its extension to include "Health first" should involve little extra expense or labor. The success of the safety first movement has resulted largely from the education of the working force. Education should be carried further, so as not only to prevent accidents in the plant, but to prevent disease and sickness, which are of equal if not of greater importance to all concerned.

Manufacturers who face this phase of plant operation and take the necessary steps to accomplish the desired result—the acquisition and maintenance of a healthy and fully efficient working force—will in the end profit largely, a result already perceived by those who are farsighted and accomplished by those who are progressive.

The following recommendations in regard to unhealthful conditions in some steel plants should be taken as general suggestions on methods of minimizing or eliminating the causes of lowered efficiency or physical well-being of workers rather than as a code of rules. The latter could hardly be provided because conditions differ so widely.

MEDICAL SUPERVISION OF EMPLOYEES.

Health is the workingman's capital, his stock in trade. Without health his earning capacity is limited, and those dependent on him

suffer as well as he. The workingman has a right to demand that he be not required to work beside men who are diseased or mentally deranged. All candidates for employment and all men already employed should be examined in order that those physically or mentally defective may be detected and given medical attention. Moreover, a system of medical supervision is necessary in order to prevent the introduction and spread of infectious or contagious diseases. Experienced, hard-working, and valuable employees may not be working at their full capacity because of some defect of which they are unaware. Should such conditions be brought to light and remedied, these men will be restored to full efficiency.

Again, a progressive disease may be affecting a person, so that his working period is being rapidly shortened. With a system of physical examination his condition is discovered, treatment is instituted at an earlier date, and relief made more certain. An efficient force can not be maintained with constant substitution of new men for old, especially if the duties of the workers are in sequence, for the efficiency of the whole force will be lowered to meet the ability of the new and inexperienced men.

Aside from purely business considerations, medical supervision has a humanitarian aspect. Few abnormal conditions resulting from harmful industrial environment are themselves fatal; they are underminers. The most common terminal disease is tuberculosis. Out of 140 classified occupations tuberculosis is the leading cause of death in 110. Many diseases, if discovered in their incipiency, are amenable to treatment. The affected person is usually unaware of the abnormal conditions, and their discovery before they have progressed too far is of great benefit to the individual, his family, and society at large.

PERMANENT FACILITIES NECESSARY.

In preparing to institute a system of medical supervision provision should be made for permanent facilities. A space should be set aside for the purpose and the necessary equipment installed. It is desirable to have the examining room convenient to the working places of the men, and quiet, in order to insure accurate examination of the heart, the lungs, and the sense of hearing. The facilities for making examinations should be permanent and therefore of substantial construction. Provision should be made for ample natural illumination and ventilation in addition to that artificially provided. The room should be orderly and clean at all times. An important essential is a satisfactory interior arrangement of the examining room, so that an examination can proceed in a systematic manner, thus allowing the greatest number of accurate and complete examinations in a given time. This detail is of especial importance when many men are to be examined.

Another important feature is that of blank forms on which to record the data obtained as the examination proceeds. A form should omit incomplete or unimportant items, and provide for all essential data in the logical sequence of an examination, so that clerical labor will be minimized in recording the findings and in making subsequent reference. Information relative to the age, height, weight, and similar data may be taken by some responsible person other than the examining physician. The records of the examinations should, of course, be filed for future reference. If doubt arises as to the physical condition of any men examined—as it often may—the cards of these individuals should be marked to show the desirability of a reexamination in order to determine the existence of any abnormal condition, so that early measures may be taken for its correction.

The system of medical supervision should aim to (1) maintain the health of the working force; (2) provide advice for ailments and on "how to keep well"; (3) assist the management in providing employment for workers partly or wholly incapacitated by reason of physical infirmity from doing their accustomed work.

Just as the employment agent determines the fitness of the applicant as to experience, training, etc., so the physician determines his physical and mental qualifications. The employment agent is given for reference the physician's certificate of examination. This should be brief, yet informative, and free from obscure medical terms. For convenience this certificate may be made a part of the original physical-examination blank to be filled in at the time of the examination, detached upon completion, and sent to the employment office.

Those who employ many men are fully aware of the importance of placing each man at the kind of work he is best qualified to do, and those who have ability in choosing men should be in charge of the employment agency.

DUTIES OF MEDICAL SUPERVISOR.

In the past it has been customary for the attending physician of an industrial plant to confine his activities to the treatment of those injured or taken acutely ill while at work and to give only a part of his time to these duties. The physician should be a whole-time employee and his expert knowledge and training along other lines should be utilized. His duties should include medical examination of candidates for employment, periodical examination, and supervision of the health of the working force. In addition, it is advisable that he make sanitary inspections of the plant with the view to eliminating, where possible, the health hazards found in any working location or attending any occupation. He may have supervision

of the condition of the wash and locker rooms, water-closets and baths, and the supply of drinking water. It is also important that he cooperate with the "safety first" men of the plant in an endeavor to educate the force along the line of health preservation.

Another important duty that a company may take up is that of personal hygiene. Employees of experience and skill whose services are of value may be living in such unhygienic surroundings that their period of service is being rapidly cut short. By encouragement and advice the conditions can be corrected and sickness in the family prevented. Many progressive and far-sighted employers have found this kind of work among the families of the employees to be of great value. In addition, such activity by the employer benefits not only himself and his employees but society at large.

To sum up, then, the plant physician should be a whole-time official and his duties should be somewhat as follows:

(1) Emergency relief to those injured or taken acutely ill while at work.

(2) Examination of candidates for employment.

(3) Medical supervision of the entire working force, particularly to ascertain a diseased or abnormal condition of any worker and to institute measures for its relief.

(4) Supervision of the sanitary condition of the plant as a whole, and particularly the working conditions to which the employees are exposed.

(5) Education of the force to the necessity of personal hygiene.

(6) Furtherance of hygiene in the homes of the employees.

PLANT HOSPITAL.

A hospital equipped to give emergency relief to those injured or taken ill while at work is an indispensable adjunct to all modern industrial establishments. The building should be of substantial construction, conveniently situated, and kept neat and attractive at all times. Provision should be made for ample illumination and ventilation, both artificial and natural. At least three rooms, preferably four, are needed; one to be used for an office and waiting room, one as a dressing and operating room, and one to be supplied with one or two hospital beds to receive patients temporarily. A fourth room with additional beds is often needed. It is desirable to have the walls and ceiling light in color and of material that permits easy and thorough cleaning. The floors should be of terrazzo or other resistant and impervious material, should have cove corners, and be supplied with large hinged drains. Permanent hose connections should be installed, and a regular and thorough cleaning should be given the waiting and dressing rooms each day, and the others when used. Wainscoting of

tile or similar nonabsorbent material at least 4½ feet high should extend around each room.

The equipment will vary according to the particular needs of the plant. Before the equipment is purchased the physician should be consulted, and the necessary articles should be chosen with care. In addition to the necessary instruments, surgical supplies, drugs, etc., the following articles will be found of great convenience: A bath tub constructed to hold a stretcher and arranged for a continuous flow of water; a sanitary drinking fountain; a receptacle with automatically closing lid for infected dressings, etc.; a portable bracket lamp; a large slop sink, and a scrub-up basin with foot pedals.

A graduate trained nurse should be in constant attendance, and the physician, when not at the hospital, should be available on short notice. He must supervise all dressings and important medical work. An accurate record of cases should be kept. For cases requiring attention for a long time small cards, which state when to return, should be provided, as they tend to overcome the tendency of many patients to fail to report. In order to avoid confusion or delay at the time of an accident in plants that cover much ground, certain designated locations, which may be termed emergency or ambulance stations, should be established, each serving a specified area. An injured person is carried to the proper station, there to await the ambulance or the arrival of the physician. At each station a small first-aid outfit and a stretcher should be kept, and chosen employees should be instructed in the principles of the use of this equipment and in giving first aid. An apparatus for applying artificial respiration mechanically may sometimes be of value.

FATIGUE AS A CAUSE OF OCCUPATIONAL DISABILITY.

Undue fatigue is one of the most common causes of occupational disability; it lowers the vitality of the individual and thereby increases his susceptibility to the hazards of his occupation and to disease in general. Fatigue is also of direct practical importance. It lengthens the time necessary for the worker to perform a given amount of work, thereby decreasing the amount of work performed in a given length of time, as, for instance, a working day. In addition, it increases the liability to error and is an important causative factor of accidents. Few subjects of plant operation are of more importance than the amount and character of the work done and the prevention of accidents. Fatigue has not only been observed in the workshop, but it has been studied in the laboratory.

The causes of fatigue can be briefly summed up as follows: Laborious or fast work or long periods of work; monotony or complication of muscular movements; constant strain, as when fixed

mental or visual attention is necessary to the performance of duties; constant standing, particularly on hard, unyielding floors, such as those of cement; lack of variation in muscular exertions; or lack of periods of relaxation.

In addition to the amount and character of the work, the conditions under which it is performed have an important bearing on fatigue. For instance, exposure to high temperature and high humidity, excessively bright or improperly placed lights, loud or continued noise, and constant vibration tend to cause fatigue.

In studying the fatigue probably incident to an occupation, the following details should be considered:

Does the work involve fixed mental attention, alertness, or fixation of vision?

Is the amount of physical exertion required great or small?

Is the work rapidly or leisurely performed?

Are the movements simple or complicated?

Are they performed over and over again, or are they varied so as to break the monotony?

Is the operative subjected to any or all of the following conditions: High temperatures, high relative humidity, noise, vibration, insufficient illumination, excessively bright or harmful industrial lights, or vitiated, fume-laden, or dust-laden air?

Has the employee the proper toilet and washing facilities?

Has he an abundance of good drinking water at hand?

Is he given definite, regular, and sufficient intervals in which to rest and eat?

There is no doubt that fatigue-producing conditions can not be ignored without seriously affecting the efficiency of the working force. Methods devised for the prevention of undue fatigue have been tried and adopted and are now enthusiastically supported by the most progressive manufacturers.

RELATION OF INDUSTRIAL BUILDINGS TO HEALTH OF EMPLOYEES.

The old saying "well begun is half done" applies to building design and construction. If this receives proper attention many health problems will be much easier to solve. If provision is made at the time of building for natural illumination and ventilation, ample space, and proper flooring, a great saving in time, labor, and expense can be realized in providing these essentials.

SPACE ALLOWED FOR EACH EMPLOYEE.

Several States have prepared rules governing the amount of space to be allowed each workman. Few arbitrary rules can be given. So many factors are involved, such as the character of the work, the

processes involved, and the material handled, that each case must be studied separately. Each individual should have ample space in order to perform his duties unhampered by others. There should be sufficient space in order that close proximity to dangerous machinery or undue exposure to heat, dust, fumes, or gases, or harmful materials or products may be minimized. The subject of space is intimately associated with that of ventilation, which is discussed elsewhere. (See pp. 18–20.)

FLOORING.

Flooring affects health mainly through the liability of floors made of certain materials to retain germs of infectious diseases, injurious materials that are handled, dangerous products of manufacture, or moisture. In the steel industry, flooring may become heated and so afford a bad surface upon which to stand and work because of its being injurious to the feet. Hard, inelastic substances, such as cement or steel, make unsatisfactory floors for employees who have to be on their feet constantly. Pain or even a feeling of discomfort in the feet will materially interfere with a workman's ability properly to perform his duties, and should be prevented so far as possible. If flooring is liable to become heated it may be so laid as to prevent direct conduction of heat from the source, or may be so placed as to lessen the absorption and to facilitate the loss of heat. Floor space should be kept clean, and the floor should be so constructed as to permit easy and thorough cleansing; also, it should be kept as free as possible from obstructions. The danger from unnecessary obstructions scattered over a floor is obvious.

ILLUMINATION.

Careful attention should be given the proper lighting of the workshop and factory or of any industrial establishment. The intimate relation between good illumination and the efficiency, safety, and bodily welfare of the employee should be considered and steps taken to see that good illumination is afforded all workers. For years many have been working in the dark, yet none would venture to say that a workman could work to his full capacity unless his work were adequately and properly illuminated. The most enthusiastic supporters of proper lighting for shops are those who have taken the steps to insure it and have seen the benefits thus derived. Increased efficiency in mills, varying from 2 to 10 per cent, has been reported as a result of improved lighting conditions. The industrial commission of one State reports that in one steel plant an efficient lighting system was installed and the output at night was increased 10 per cent. To determine if this increase was due to the illumination, the

old system was tried for a time and the output fell 10 per cent. The improved lighting system was used again and the output rose to that attained before. The ill effects of bad lighting, such as impairment of eyesight, the depressing effect on the worker, and his resulting attitude toward his work and his employer, should also be considered. The relation of proper lighting to the prevention of accidents is too obvious to be dwelt upon here.

NATURAL ILLUMINATION.

As a source of light the sun is hard to beat, yet in many establishments artificial illumination is used in broad daylight. Probably no other element produces such cheer or has such psychological effect upon man as sunshine. No other illuminant has been discovered that can compare with it. The increase in efficiency and the improvement in morale in workrooms well illuminated by natural light is remarkable. In addition, sunlight has a beneficial influence on the health of the individual. The most progressive manufacturers have appreciated this fact, as is shown by the type of factory buildings now being constructed. Not long since factory buildings were built with small windows casually placed with little reference to the working places to be illuminated. Many factory buildings now being constructed almost have the appearance of a hothouse or botanical garden, nearly the entire wall area being given to window space.

To obtain sufficient natural illumination a building must be planned and constructed with that end in view. However, much can be obtained in old buildings by taking steps to improve the distribution of such light as is available. New windows may be added. Making the walls and ceilings white or a light tint will improve the distribution of light. Keeping windows clean will greatly increase the amount of light admitted. Where buildings stand close together corrugated or prismatic glass will refract the light so as to send it into the room horizontally in place of allowing it to enter slantwise toward the floor. Such window glass will also aid illumination in wide, low rooms having little window space. Another way of increasing the amount of light is to construct the roof on the so-called "saw-tooth" plan and to use skylights.

The amount of light necessary depends on several factors, the principal one being the character of work the employees do. For work of such a nature as to require attentive scrutiny too much well-diffused and well-placed natural illumination can hardly be furnished. Glare from the sun's rays or light from the sky shining directly into the eyes should be avoided. Where the duties are such as to require little use of the eyes or where self-luminous objects are handled, such as billets in a rolling mill, the illumination should

be general and well distributed rather than of great intensity. Windows should be so placed that illumination is uniform over the working area.

Rules fixing the amount of window space have been set down. Obviously, however, it is impossible to be specific, as one establishment will require more than another. In addition, the geographic and district situation of the factory will have a great influence. The brightness of the sky may be materially decreased by smoke, and will vary at different places and at the same place because of weather conditions. Therefore, each manufacturer or employer ought to study the conditions in each workshop and to make such provisions as the needs of the workers require. Sunshine is cheap and is the best illuminant we have.

ARTIFICIAL ILLUMINATION.

Although general rules may be given regarding the amount of light necessary or desirable under certain conditions, the formulation of rules to cover every case is obviously impossible because of the widely divergent conditions in each plant. It is necessary, therefore, to make a careful study of these conditions—particularly the character of work required of the employees—in order to install a lighting system that will satisfactorily meet the requirements. As a guide the following table of intensities may be consulted:

	Foot-candles.
Storage rooms, passageways, stairs, etc	0.25– 0.5
Rough manufacturing	1.25– 2.5
Fine manufacturing and close work	3.5 – 6.0
Special cases of fine work	10.0 –15.0

For general illumination, incandescent bulbs of the tungsten type, either single or in clusters, may be used. Units should, as a rule, be fixed. Arcs of either the flaming or the luminous type have also proved efficient. The luminous type is better in large buildings where the unit must be placed 30 to 40 feet above the floor, though for 25 feet and under, the tungsten bulb is to be preferred.

It is important that lighting units be so placed that the light does not shine directly into the eyes. This common error can be prevented by placing the lights well above the level of the eyes of workers. In some instances illumination from the side will be advantageous. White or light-colored walls aid greatly in reflecting and diffusing the light. Glare effects on the machinery or material or in the working zone should be avoided by arranging the light to fall from a proper angle or by adding some general illumination. It is important to be economical with the light arranging and to have the greatest intensity where actual work is being done, although a certain amount of general illumination is desirable in order to

avoid harsh contrasts. Care should be exercised in avoiding troublesome shadows, not only those from fixed objects, but also those cast by a worker's body. More attention should be given these requirements in locating the units than to arrangement of the light sources in artistic patterns. Unsteady and flickering lights should be avoided.

It is both hygienic and economical to provide light units with reflectors of a proper design. A good reflector will add 25 to 50 per cent to the efficiency of the light, as approximately 83 per cent of the light from a tungsten bulb is thrown horizontally. For industrial establishments concentration of light is desired in many places, though it should be evenly distributed over the working spaces and should be combined with some general illumination. Reflectors should be made of material that minimizes the danger of breakage and is unaffected by moisture, gases, or fumes, and should permit easy and thorough cleaning and polishing. The shape of the reflectors should be carefully chosen to meet the requirements. For illumination of workbenches, tables, desks, or individually operated machines, the light should be thrown on the working plane and not wasted on the surrounding floor area. For this purpose the bowl-shaped half reflector should be used. It may be adjusted to any angle to meet conditions by some one in charge of the lighting system. The adjusting of lights should hardly be left to the operatives. Where large unit lamps are hung 20 to 30 feet from the floor a type of reflector that will spread the light generally is best. The common mistake of using types of lamps and reflectors not suited to each other should be avoided.

INTENSE OR HARMFUL LIGHTS.

The importance of protecting the workmen from injurious lights needs no discussion. Through neglect to take necessary precautions the services of valuable men may be lost. In addition, errors in judgment, due to impaired eyesight of the employee, may prove expensive to the operator. An error on the part of the Bessemer blower, for example, may cause the loss of the blow or the complication of the process. Such occupations as those of metal grinding or buffing, where the workman is required to watch more or less intently a bright surface, may injure the eye. Harmful lights are found mostly in steel plants, foundries, or forge and weld shops. In addition several lights highly injurious to an unprotected eye have recently come into use, such as the arc weld, oxyhydrogen and oxyacetylene flames, and the thermit weld.

Light may be harmful either because of its intensity or because of its spectrum. It is possible also that radiant heat energy may

have some effect upon the eye. The various lights to be met and the temperatures, in degrees Fahrenheit, that accompany them are as follows:

Process.	Temperature.
Electric arc	6,200
Electric arc under pressure	6,450
Oxyhydrogen flame	3,600
Oxyacetylene flame	4,350
Thermit weld flame	4,500
Metal at tapping hole	2,300 to 2,700
Metal at tuyères (blast furnace)	2,300 to 3,500
Open-hearth furnace flame	3,400 to 3,600
Bessemer converter	3,400 to 3,600
Open hearth in ladle	2,800 to 2,900
Bessemer	2,800 to 2,900
Soaking pits:	
Low-carbon billets	2,500 to 2,600
High-carbon billets	2,200
Gas-heating furnace	2,400 to 2,800
Large gas-heating furnace	2,900 to 3,200

GOGGLES.

The best way to avoid injurious effects from the lights mentioned is to protect the eye with glasses or goggles of special coloring or composition to meet the character of the light. Such goggles should have the following features:

(1) Shut out harmful rays.

(2) Reduce the retinal image to a safe brightness.

(3) Not unduly hinder vision of other objects besides those on which the employee is working.

(4) Be light in weight, well fitted, and as comfortable to wear as possible.

(5) Have no metal parts that touch the skin.

(6) Be fitted with a flange back of each lens so as to prevent glass from entering the eye in case the glass is broken by flying objects.

(7) Be of such coloring that color perception is not unduly disturbed.

The requisite last mentioned is important where the eye is to judge, from color and appearance, the condition or temperature of the material being heated. Therefore, in choosing goggles, the intensity and character of the light, the heat which may attend it, and the character of the duties of those workers that are to wear them should all be considered. The comfort of the wearer must be considered in order to overcome his natural disinclination to wear these protective devices.

Investigation of the spectral position of the light from the flames and processes mentioned has been made, and by photography and experimentation glasses of a certain coloring and composition have been devised that at least greatly reduce the hazard. A number of protective glasses now on the market seem to meet most requirements. Some have an advantage in that the relation of temperature, intensity, and color of the light appear much the same to the protected as to the unobstructed eye—an important item. The use of smoked glasses has been found unsatisfactory because they interfere with proper color discrimination and offer little protection.

In order to cut down the intensity of a light to safe brightness a neutral-tinted glass is the best so far devised. The density of this neutral glass should be varied to meet the intensity of the light to which the worker is exposed. For oxyhydrogen or oxyacetylene flames it may be of less density than for arc-welding; and for the light from molten iron, steel, or other metal, a still lower density will suffice. For the light of an open hearth or of the open-hearth steel a clear cobalt-blue glass has been found best. In welding processes, except the lapweld, etc., the glasses are preferably fitted into a helmet that is light, well ventilated, and as comfortable to wear as possible. Employees should be furnished with goggles, and should be instructed in their use and in the importance of avoiding the hazard that may accompany the lights they meet in their duties. The employers should see that the goggles are worn. Each workman should be given a set for his use, and should be required to keep them clean and in order, to report when they are broken, and to receive new lenses immediately; he should be prohibited also from exchanging glasses with a fellow workman. Glasses, or other protective devices, when surrendered by one worker, should be thoroughly cleaned before being issued to another.

Another injurious light making goggles highly desirable is from the sudden and blinding flashes that occur at times around electrically operated machinery. Such flashes may be caused by the arc of a short circuit when a fuse blows out, by loose connections, by separation of electrical contacts, by too strong arcs, by loose and defective wiring, or other conditions. Such flashes may cause a severe inflammatory and painful condition of the eyes, and may result in temporary or permanent loss of vision.

Accidents and injuries to the eyes are among the most common that happen to a worker. Aside from the suffering of the worker there is inconvenience to the employer and a distinct economic loss to the public. Statisticians estimate that there are more than 80,000 men in the United States who are blind because their eyes were not

protected while at work. This is a fearful indictment against the negligence of the persons responsible.

NOISE AS A CAUSE OF LOWERED EFFICIENCY.

Excessive or continuous noise has a deleterious effect on the more sensitive functioning parts of the ear. That men exposed to such noise—boiler makers, for instance—become more or less hard of hearing is well known.

Much of the noise in any industrial plant is, of course, a compulsory hazard, and its elimination in many plants is wholly impossible. It could, however, be made to affect a relatively small number of men only, and no doubt many noises could be eliminated. The sources of noise in an industrial plant are too numerous to be discussed here.

Although many workers affirm that they become thoroughly accustomed to many of these sounds, the effect of the noise on the nervous system persists, unless, by continuous exposure, dullness of hearing or deafness is produced. The influence of continuous and unnatural noise in causing fatigue is well known. The installation of silent signals for other than danger signals would have advantages over the blowing of whistles; for should the whistles not be heard or properly understood at the time they are blown some serious mishap may arise, whereas silent signals are continuous.

In one shop in the Pittsburgh district an endeavor is being made to do away with unnecessary noise. The difference between it and others is astonishing. The men do their work in an orderly, rapid manner; there is no confusion, no noise. If danger signals are sounded, they can be distinctly heard. After one has been in a noisy shop for some time a stay in this shop is actually restful. Light signals have been used where the duties of the workers were in sequence and have proved a great success.

VENTILATION.

Adequate ventilation of the workship should be considered from two points of view: (1) That of air renewal; (2) that of removal of products formed in the industrial processes.

The removal of air in a workship does not differ in essentials from that in any other building; and it is as difficult to formulate any definite rules, for there are so many factors to be considered that each case must be taken up separately. It is preferable that air renewal be accomplished so far as possible by natural means, through windows, transoms, skylights, etc., and attention should be given these fixtures with this end in view. They should be of ample size and readily removable, being preferably on pivots to permit open-

ing in the horizontal or vertical plane. This arrangement will make it possible, also, to control in some degree the air currents and to direct them where desired. Where it becomes necessary to heat the air, steam or hot-water coils may be placed below or near the intakes, windows, ventilators, and the like.

The products formed, such as fumes, gases, or dust, and harmful conditions of temperature or humidity incident to industrial processes, must receive additional attention. The correction of such conditions is somewhat complex. In a steel plant the following dusts may be found:

(1) Dust from storage bins, including coke dust, limestone dust, iron ore dust.

(2) Dust from the foundry, such as sand, clay, and coke dust, a small quantity of graphite, and particles of metal and of emery.

(3) Blast-furnace dust (flue dust) and graphite.

(4) Mixing-house dusts, clay, limestone, dolomite, etc.

(5) Dust from gas producers, including soot and other carbon products.

(6) Dust from other departments, including graphite and oxides of metals, as iron and manganese.

(7) Lime dust from wire-drawing departments.

Inhalation of dust is one of the greatest occupational hazards. Besides irritating the eyes and skin, and predisposing to tuberculosis, it is the direct cause of a number of respiratory disorders. This effect of dust is so pronounced that a number of life insurance companies have refused to accept as risks those who are engaged in dusty occupations. Indeed, there is probably no condition that should receive more attention, or should be more speedily and effectively remedied, than that of suspended matter in the air.

The formation, escape, and distribution of dusts can be prevented, or the dusts can be removed from the air when once set free. Prevention is far more desirable, and in many instances may be done by sprinkling, as at the stockyards.

Where it is impracticable or impossible to prevent dust from becoming suspended in the air, the process of manufacture that produces the dust should be carried on in a separate, well-ventilated location, as few persons as possible should be exposed, and they should all be required to wear respirators. A respirator should effectively remove all suspended matter from the inhaled air, should be light and comfortable to wear, and should not interfere materially with the respiration; however, a perfectly satisfactory respirator is yet to be devised.

The only effective means of removing dust in workshops is by a carefully designed and constructed exhaust system. The place to

collect and remove dust is at its source. Where this is at grinding or mixing wheels a suitable hood of substantial construction, preferably of steel, should be installed.

At grinding or polishing wheels the exhaust pipe should not be less than 3 inches in diameter when leading from a wheel 6 inches in diameter, or less than 5 inches for a wheel 6 to 20 inches in diameter, and for larger wheels it should be at least 6 inches in diameter. Furthermore, it should be full size to the main suction line, should be free from acute turns, bends, or angles, and should enter the main line at an angle of 45° or less. At the end of the main a suitable collector must be installed and disposal of the dusts made. Laws regulating the construction and design of exhaust systems have been made in several States, one of which requires that the suction shall be sufficient to raise a column of water 5 inches in a U tube.

After systems for the removal of dusts have been installed, there must be frequent inspection and adequate maintenance.

Fumes, gases, or smoke should also be prevented from polluting the air of the working locations. Every charcoal, coke, or coal fire, such as those in foundries, should be supplied with an effective exhaust or chimney, and the gases resulting from the combustion should never be allowed to escape into the air of the workroom. The escape of products of combustion from the hoppers of gas producers must be prevented, and the working location of those employed should be free and open or effectively ventilated. Similar precautions should be taken at the cupola and reheating furnaces.

TEMPERATURE AND HUMIDITY.

The combination of high temperature and high humidity in many modern industrial establishments eventually affects injuriously the health of those exposed, especially if the exposure is prolonged or attended by physical exertion. The economic effect of such conditions is a decrease in the efficiency of the worker—that is, a lowering in the amount and character of the work performed. Continued exposure to high temperature and humidity increases the susceptibility to disease and may cause muscular and joint pains, aches, cramps, and, in extreme cases, heat exhaustion. Continued exposure will eventually cause anemia and skin eruptions, and tends to induce premature old age. There seems little doubt that the temperature to which many workmen are exposed could be materially lowered and that the duration of the exposure and the amount of physical exertion required while so exposed could be decreased.

Buildings in which the processes are such as to require those employed therein to be subjected to high temperature or high humidity

should be so constructed as to aid, by all natural means, a free circulation of the air. They should be large, with ample floor space. It is of special importance that the roof be placed high and provision made for the escape of heated air. The temperature can also be materially lowered by leaving several large openings in the walls, though undue drafts on those workmen who are overheated should be avoided. A rapid circulation of air created by natural means alone lowered the temperature 30° F. in the working location at one steel plant in the Pittsburgh district.

Heat should be prevented as much as possible from radiating from its source. Water-cooled doors have done a great deal toward this end. By erecting shields and screens with asbestos coverings between the source of heat and the working location of the men a decrease of temperature of 20° F. has been obtained. Another efficient method is the use of forced-air blasts. This method has greatly lowered the temperature and improved the working conditions of the men, thereby increasing their efficiency, in a tube plant in the Pittsburgh district. The blast is obtained by means of powerful electrically driven fans, which force the air on the men toward the source of heat. Besides lowering the temperature to which men are exposed, the length of the exposure should be made as short as practicable by arranging the work so that each man is employed at his particular duty for a short period. As mentioned elsewhere, the harmful effects of heat are increased if physical exertion be performed while the workmen are exposed; hence this should be reduced as much as possible.

One of the most important necessities for all workers exposed to heat is a shower bath on completion of the turn of duty. The water should be tepid and should strike the body with force in a fine spray; the bath should not be of long duration and should be followed by a brisk rub down with a rough towel. Employees ought to be educated to avoid exposure to sudden changes in temperature, not only while at work in hot locations, but at the bath. By avoiding such exposure they will avoid many complaints, such as muscular pains, stiff joints, and coughs. It is also of great importance that employees at these hot jobs be supplied with an ample amount of pure drinking water of correct temperature, as stated on page 25, and that it be so conveniently placed and so available that the employee will frequently drink in small quantities and not be tempted to drink large quantities infrequently—one cause of many gastro-intestinal complaints among workmen exposed to the heat.

HOURS OF DUTY.

The length of time during which a man actively works has, as all understand, a direct bearing on fatigue. In addition, the time that he is on duty, but not at active physical exertion, must be considered, as

some of his responsibilities are still present—he is more or less alert and watchful, and is being subjected to all the hazards of his occupation and to the causes of fatigue with the exception of muscular exertion. Many establishments, in different industries, have obtained more and better results from the efforts of their employees by shortening the hours of work. The reason is obvious. After a certain amount of exertion for a given time the efficiency of the employee rapidly falls. Should the worker be required to continue, so much fatigue ensues that complete recovery does not take place before he enters on the new turn of duty. The result of having employees start work before being fully recovered from the fatigue of the previous turn of duty can be readily surmised.

As the faster an individual works the earlier the onset of fatigue, the speed at which the work is performed should be regulated. Moreover, the muscular movements necessary in the performance of the duties should be so varied as to prevent monotony.

WASHING FACILITIES.

WASH AND LOCKER ROOMS.

The standards of all American manufacturers will soon require sanitary washing and dressing rooms for employees, an obligation on the part of the employer that the most thoughtful and progressive have already met. Workmen should be able to go to and from their work clean and neat in street clothing, but this is impossible unless accommodations are supplied that will enable them to store their street clothing and change to working garments on coming to work and to wash and change to their street clothing again on leaving. The effect on the morale of the force, their attitude toward their work and employer, is an aspect of this problem that should not be overlooked.

BATHS.

The refreshing effect that a good bath has on a man after a turn of duty is well appreciated by all who make a habit of taking one after a day's hard work. It relieves the mind from the associations of the day's labor, furnishes a change, and allows a man to go home clean and neat with a sense of duty well accomplished—all the more ready to assume the next day's work with additional vim and vigor. The effects of a bath on the body, especially if the bather is fatigued, have been studied scientifically. Other things being equal, the effects differ according to the temperature of the water, the duration of the bath, and the force with which the water comes in contact with the skin. A hot bath should be avoided, or taken only long enough to cleanse the body. A tepid shower bath of fine spray that strikes the

body with force is desirable. The fine spray is also more economical in the use of water. Prolonged cold or hot baths should be avoided by those who are overheated or very tired All baths ought to be followed by a brisk rub-down with a rough towel, and exposure to sudden changes in temperature should be avoided.

Investigation shows that shower baths are generally preferable to tub baths in industrial plants. The showers should be placed in stalls at least 3 by 5 feet in size, and at least one shower should be furnished to every 20 men, this estimate to be based on the maximum number employed on any one turn of duty in the department for which the baths are designed. The baths should be well and substantially housed; the walls and flooring being of resistant, nonabsorbent material, smooth and light in color, and permitting thorough and easy cleansing by flushing from hose connections installed for this purpose. Floors should slope at least one-fourth inch to the foot, in order that waste water may drain satisfactorily. The baths should be supplied with both hot and cold water, controlled by a nonscalding valve so placed that it can be operated by the bather without standing under the water, and piping should be so placed that the bather can not come into contact with hot-water pipes. A clothes hook, sponge cup, and small folding seat in each booth will add greatly to the convenience of the employees. All baths should be convenient to locker or dressing rooms and preferably in the same building. The baths should be kept clean, neat, and in good working condition at all times by a man detailed solely for this work.

WASH BASINS.

Facilities for washing the hands and face or upper part of the body should be supplied to all workers and should be greater in number than the baths. At least one unit for every six men is recommended, the estimate being based on any one turn of duty in the department for which the washing facilities are provided. Two-sided troughs, sloping well toward a drain and supplied with gooseneck sprays spaced on 2-foot centers will obviate the cleaning necessary if bowls are used. Also they are more sanitary and will increase the number of men that can be accommodated within a given length of time. Less water will be used with such sprays than with ordinary bowls.

It is desirable that each spray be controlled by two foot pedals which will enable the washer to obtain the desired temperature by regulating the pressure of one foot or the other. After the employee releases the foot pressure on the valve and steps away, the unit is ready to accommodate the next in line without the delay incident to emptying, cleansing, and again filling a bowl.

A nail brush should be supplied each man for his exclusive use.

LOCKERS.

Some convenient place in which to store clothing, toilet articles, and personal belongings should be afforded every employee. Each place should be ample in size, with an available floor area of at least 12 by 15 inches. If lockers are supplied they should be of substantial construction, preferably of steel, and well ventilated and at least 4½ feet high. Each should be numbered, supplied with a lock or combination, and assigned to one individual who is held responsible for its cleanliness. It is preferable to have two shelves and several clothes hooks in each. If the tops are sloping they will not be catchalls. Booths should be periodically emptied and thoroughly cleansed.

WATER-CLOSETS.

Attention to the normal physiological functions of the body is necessary in order to maintain health. Facilities that will encourage the employee to attend to these functions should be installed; for this reason, too, the water-closets should be conveniently located and should insure privacy. To prevent the introduction and spread of disease they must be sanitary.

Water-closets should be substantially housed in a well-illuminated and well-ventilated building. The walls and floors should be of nonabsorbent material, such as cement; the walls should be light in color, smooth, and permit easy and thorough cleaning. There should be at least 10 square feet of floor space allowed for each unit. It is wise to have the windows made so as to open easily. The installation of permanent hose connections for flushing is desirable. Correct ventilation of these places consists not so much in the supplying of fresh air as in the rapid removal of disagreeable odors as they arise. One person may well be employed to keep the closets clean and orderly and to prevent them from becoming a loafing place.

A greater number of small installations placed convenient to the working locations of the workmen is to be preferred to a few large installations centrally placed. There should be at least one seat to every 15 persons of the force to be accommodated. Individual flushing bowls of vitrified earthenware, porcelain, or heavily enameled cast iron should be installed. Sufficient water amply to flush each bowl and to submerge any matter in it should obviously be held in the bowl. The rim-flushed type with visible trap seal is to be preferred, the pan, plunger, or offset type not being so satisfactory. For the comfort of the user the seat should be made of wood or other nonheat-absorbent material and the opening measure at least 7 by 11 inches. The U-shaped seat is sanitary. The seat should be varnished or by other means be made impervious to water. In order to insure

privacy it is desirable to partition off each unit in a space not less than 3½ feet wide; an equal distance from the front of the seat to the door is desirable. The door and the partitions should be at least 4 feet high and raised off the floor 6 inches; they should be light colored and of such material as will permit repeated, easy, and thorough cleaning. All plumbing should be so placed as not to interfere with cleaning. Clothes hooks should be installed, and an adequate amount of toilet paper should be supplied at all times. If the closets are not adjacent to the washing accommodations, an adequate number of the latter should be installed.

In addition urinals are desirable. These should be kept in a sanitary condition at all times, be convenient to places of work, and should insure privacy. The wall or vertical flushing type are to be preferred. It would be well to have small partitions about 34 inches apart separating each. It is important that the floor in front slope toward the drain and be constructed of concrete, cement, asphalt, or some similar nonabsorbent material. The urinals should be adequately flushed and should periodically receive a thorough cleansing. It may be remarked here that many of the so-called "disinfectants" now on the market are unreliable.

DRINKING WATER.

Because of the intimate relation existing between drinking water and health, and the dependence of working efficiency on the latter, good drinking water is an important item in every industrial plant—a fact that has been fully realized by the most progressive operators. However, in many plants drinking facilities are installed in a haphazard way, with an evident lack of consideration of plant conditions, the character of the work performed by the employees, or the number of drinking places required. As a result, much time, money, and labor have been misspent, whereas had the special requirements in each instance received due consideration and been amply met, the beneficial results of good drinking-water supplies would have been more evident.

REQUIREMENTS OF A DRINKING-WATER SYSTEM.

The requirements of a good drinking-water system are, in order of their importance, as follows:

(1) The purity of the water should be unquestionable.

(2) The supply should be adequate.

(3) The water should be so distributed as to preclude all possibility of contamination.

(4) The water should be of a proper temperature.

PURITY.

Purity, the first requirement, needs no discussion, as impure water is known by all to be a common cause of sickness and disease.

ADEQUATE SUPPLY.

It is important that employees be encouraged to drink sufficient water to meet the physiological needs of a man at work. One of the most common dietetic errors is the failure to drink enough water. It is equally as important that employees be enabled to drink the amount required for the day at times and in quantities that will give the most beneficial results. Workers should be encouraged to drink plenty of water, but it should be drunk in small quantities often, not in large quantities at infrequent intervals, a practice that often results in gastrointestinal disorders. In order to have the workers drink the necessary amount in the proper manner the drinking facilities must be conveniently situated in relation to the employees' working zone and be accessible at all times. The water should be free from odor, color, and taste, of a proper temperature, and obtained at a fixture that is clean, attractive, and kept in working order. In addition, employees should be afforded frequent opportunities to leave their places of work in order to drink.

On the average, a healthy man requires about 2 quarts of water a day, in addition to the pint or more that is taken in as an ingredient of solid food. This quantity will vary considerably under different conditions, and so, in planning the installation of a drinking-water system and in estimating the quantity of water to be supplied per capita, due consideration should be given to the existing conditions that will influence the quantity required by the employees. If, for instance, they perform physical labor more water will be required than if their work is sedentary. Again, the quantity of water required by those exposed to high temperature, either by reason of the character of their work or through natural weather conditions, will greatly exceed that required by those whose working place has a lower temperature.

Moreover, the palatability of the water, its convenience, and the frequency of the opportunities afforded the employees to leave their work to drink will influence the quantity consumed. In addition to these factors a due allowance must be made for waste, which will be greater than most estimates.

METHODS OF DISTRIBUTION.

The prime requisite of a method of distribution is that it preclude all possibility of contamination of the water or the transmission of disease from one employee to another. The common drinking cup and bucket are to be condemned. Besides being insanitary, such a

method of distribution is wasteful and expensive. The most satisfactory means of distribution is the sanitary drinking fountain. It is worthy of note, however, that all drinking fountains are not sanitary. This may be due either to ignorance or negligence of the drinker or to faulty design and construction of the fount. Many persons in drinking from a fountain place their lips on the outlet or other parts of the fount, thereby contaminating it and rendering it liable to transmit disease. A placard placed at the fount telling drinkers not to drink in this manner will give instruction sorely needed by many. However, the best way to minimize this danger is to install fountains of a design that makes the practice difficult; in other words, the drinker should be compelled to drink from the flowing stream. In order to accomplish this the water must rise with force from the outlet in a jet one-fourth to three-eighths of an inch thick and about 4 to 6 inches high.

The common defect with many so-called sanitary drinking fountains is that either because of the shape or the size of the outlet or because of deficient water pressure the jet of water is not thrown high enough. These founts should be supplied with a bowl of adequate size to prevent splashing and a drain pipe to carry away the waste water. They should also be fitted with a strong spring valve to insure prompt and complete opening and closing. More attention should be given to these qualities of a drinking fountain than to the artistic appearance of its mounting, pedestal, etc.

Particular attention should be given to the situation of drinking fountains. Before the fountains are installed the exact number and working location of the maximum number of employees that are to be supplied in any department should be determined and the founts so placed as to be conveniently accessible to them at all times.

TEMPERATURE OF THE WATER.

The temperature of drinking water supplied to workmen is very important. If the water is too warm it loses its palatability and an insufficient quantity is drunk to meet the physiological requirements of a man at work. However, should it be of too low a temperature it is likely to cause gastro-intestinal disorders, especially among those who in the performance of their duties are exposed to high temperature. A temperature of about 55° F. is satisfactory. To obtain this temperature refrigeration of some sort must be had. Cooling by placing ice in direct contact with the water is usually unsatisfactory because the resulting temperature may be inconstant, and because there is danger of contaminating the water with impure ice or ice that has not been handled in a sanitary manner. Wherever the size of the drinking-water system justifies, mechanical refrigeration

should be installed. Before a refrigerating machine is selected both the ammonia and the sulphur dioxide machines should be considered and assurances had that the following requirements will be fulfilled:

(1) That no opportunity is afforded for contamination of the water.

(2) That the water supplied to the machine from the mains will be reduced in temperature.

(3) That the water will be delivered to the consumer at the proper temperature.

(4) That the water returned to the machine from the distributing lines will be reduced in temperature.

(5) That frictional loss of head in the circulating system will be overcome.

(6) That the installation, operation, and upkeep of the machine will involve no great cost.

(7) That the machine is of such construction as to permit easy and thorough cleaning.

DRINKING-WATER SYSTEMS FOR SMALL PLANTS.

In industrial plants where the number of employees is small it is often impracticable to install the type of drinking-water system described above. In these plants there are several other means that, if care is taken in their installation and operation, will supply the operatives with water in a satisfactory manner.

A good method of distribution for small plants is by portable fountains. These are also especially useful in large plants or those covering an extensive area, because in such plants groups of employees are engaged from time to time in different places where it would be impracticable to install stationary founts and where it would be difficult, owing to the character of their duties or their working location, to keep employees supplied with individual drinking cups. A portable fount consists of a reservoir of a capacity of 25 to 30 gallons placed on a stand 3 or 4 feet high and having, in place of a faucet, a pipe leading to a bubbler fitted with a strong spring valve and surrounded by a bowl connected with a drainpipe. These founts should be constructed of strong, light material, and the reservoir should have a tight-fitting cover.

If a refrigerating machine is on the grounds, cooled water may be carried to this reservoir in buckets. If this practice is adopted care should be taken to reduce to a minimum the possibility of contaminating the water. The reservoir and buckets should be regularly and thoroughly cleaned and the covers kept tightly closed. If no refrigerating machine is operated ice may be used, though, as previously discussed, the use of ice is open to several objections. The ice should never be placed in the water. It may be placed either around the reservoir or in a well-insulated box through which

the pipe leading from the reservoir to the fount passes in a long coil However, a common fault with this arrangement is that the water in the coil is reduced to a temperature too low and after this relatively small quantity has been drawn off that coming from the reservoir does not remain in the coils long enough to be cooled. As a result the first water drawn is ice cold and that drawn immediately afterwards is too warm to be palatable.

In a large industrial plant in the Pittsburgh district water is taken direct from the mains through a sanitary fount, but first passes through a coil in a large steel box containing ice which surrounds the coil. As the working parts of the fount are properly cared for, and as a little experimentation has shown the quantity of ice to be used, this method has proved satisfactory in this plant.

RESTAURANTS.

It is very important that a workingman be supplied with ample food of good quality. He should, in addition, be allowed a certain definite time in which to clean up, rest, and eat at leisure. The operator who makes this provision for his working force will in the end profit in the amount and character of work done by his employees. The food should be both warm and fresh, something difficult to obtain when a lunch bucket is carried. Eating in the immediate vicinity of the working location with the evidences of work still on the hands and face and at such odd moments as may be available does not offer opportunities for rest or diversion, or the proper conditions under which to eat.

For some time restaurants have been established in many plants in several industries. More recently they have been established in certain steel plants and operated with success. The officials of these plants are enthusiastic in their support. The necessary equipment, building, etc., will, of course, vary according to the demands. However, a few general statements may be made.

The building should be conveniently placed, attractive in appearance, and of substantial construction. All windows and doors should be screened, suitable garbage receptacles with tight-fitting lids supplied, and their use should be enforced. Floors should be of cement or similar nonabsorbent material; permanent hose connections should be installed, and such arrangements should be made as will be necessary to permit thorough and easy cleaning. Installation of modern kitchen equipment, such as a dishwasher, has in some instances proved advantageous. Sufficient store room and ice-box room should be available. Movable tables with opalite-tiling tops and stools fitted into the floor and readily removable will diminish the work necessary to maintain neat and sanitary conditions.

Either the restaurant should be directly under the jurisdiction of the plant officials, or, if the concession is granted to outside persons,

strict supervision as to the character and cost of the food and the conditions under which it is prepared and served should be exercised by the officials. A person competent and experienced in the management of such establishments should obviously be employed to handle the detailed and routine business connected with its operation. The concern will find it well to furnish the food at cost, covering, of course, depreciation in equipment, breakage, etc. Tobaccos and soft drinks may be sold under certain conditions and the profit applied to the general fund. The menu of a restaurant, operated in a large steel plant, is given below. This restaurant has proved very popular among the men, is a success in every way, and is enthusiastically supported by the plant officials.

Menu of restaurant in large steel plant.

REGULAR MENU.

Macaroni soup	$0.03
Roast beef	.10
Baked pork and sausage	.10
New potatoes (boiled)	.05
Sweet corn	.05
Cantaloupe	.05
Watermelon	.05
Bread pudding	.05
Pies (one-half cut):	
Raisin	.05
Peach	.05
Apple	.05
Apricot	.05
Buttermilk and sweet milk (pint glass)	.05
Tea and coffee	.05
Bread (three slices)	.02
Crackers	.02

SHORT-ORDER MENU.

Small steak	$0.15
Pork chops	.15
Bacon and eggs	.15
German fried potatoes	.05
Two eggs, bread, and butter	.10
Egg sandwich	.05
Ham-and-egg sandwich	.10
Ham and eggs	.15
Wheat cakes and sirup	.10

Served from 2.00 p. m. to 10.00 a. m. daily.

SUMMER SPECIALS.

Ice cream	$0.05
Lemonade	.05
Root beer, ginger ale, lemon sour, all kinds of pop, etc	.05
Cold roast pork	.10
Cold roast beef	.10

Soup, meat, and vegetables changed every day.

COOPERATION BETWEEN EMPLOYER AND EMPLOYEE.

Cooperation between the employer and the employee is necessary to obtain the ends described in this report. Without mutual aid success will be only partial. In the absence of conveniences and accommodations or good working conditions, no matter how well informed or painstaking the employee may be, his endeavors to maintain health and efficiency will be handicapped. On the other hand, all provisions for his well-being made by the employer will be futile, if the worker through ignorance or carelessness fails to observe the principles of health preservation. The problem here is the same as that met by the "safety first" movement and can be solved by the same means, namely, education, for education has been the great factor in the success of that movement. Continued, systematic instruction and education along the line of "health first" could be incorporated with that of the safety-first work with little additional expense or labor, now that the latter work is so well organized and conducted.

As mentioned elsewhere, the plant physician should supervise this health-first work. If his knowledge and training be combined with the practical experience of the safety engineer, this educational propaganda should be very successful. The instruction should be carried somewhat further among the foremen or those in positions of responsibility, though all the employees ought to be made thoroughly familiar with the basic principles of personal hygiene. It is thought that printed circulars in plain words which will bring the fundamental facts forcibly to the attention of the workers should be distributed among them. A circular could be inserted in each pay envelope and labeled, "Take this home and read it over with your family." This plan would stimulate more interest and discussion than would signs posted in the plant or verbal instructions which may attract little attention or be quickly forgotten. A few such circulars, to be regarded merely as suggestions, which may be altered to meet requirements, are given below.

PROTECT YOUR EYES.

What would you do if you were blind? What would your family do? Could you hold down your job if you could not see well? Did you ever see an unfortunate blind man being led about the streets?

Take no chances with your eyes. Did you ever know of a fellow who lost his job or had to quit work because his eyes went back on him?

Wear the goggles that are made for the protection of your eyes—not only the kind that are made to protect your eyes from being put out by a flying chip in an instant, but also those that are made to prevent the strong lights from putting out your eyes little by little every day. You may think that because the lights don't bother you now you have got used to them. But take no chances. Be on the safe side.

Don't look into the furnace, at the converter flame, or at the hot metal any more than you have to to do your work. Don't watch the fellow welding.

If you work at a bench or lathe don't hang the light so that it shines directly into your eyes. Put the light up above the level of your eyes and put a good reflector on it so that it throws the light down on your work. Keep the globe and reflector clean. When you read have the light at your back, so that it comes over your shoulder and falls on what you are reading.

Use lots of light. You will need good eyes to do good work. Do you know that there are 80,000 men in the United States who are blind because their eyes were not protected while working? The workmen's compensation law will never compensate you for the loss of your eyesight.

SEE THE DOCTOR.

When you feel sick or get hurt, no matter how little you think it is, go to the doctor. You may think it is nothing, but it may be very important. You don't know; the doctor does. That's his business. He will tell you whether it is serious, tell you what to do, and give you treatment.

You can't do your work if you are sick and you can't be happy. If you get something in your eye, no matter how small, don't let a fellow workman take it out. If you do your eye may be permanently injured, or he may innocently give you a bad eye disease. He may be a good craftsman, but he doesn't know the doctor's business. Take no chances.

If you cut yourself, have the doctor clean the cut and dress it. That's his business and what he's paid for. He can do it so that the cut will get well soon. If you don't, it may get full of pus, swell up, and be very painful. It may cause you to lose time.

Whenever you feel sick or get hurt, go to the doctor. Better see him once on the company's time than to see him many times later on your own time.

BE EXAMINED BY A DOCTOR.

A good examination by the doctor is just like giving a machine a good overhauling. You may have some disease or ailment that is just starting and you don't know it. The doctor will find out and tell you what to do and treat you. If you wait until you feel sick it may be too late or it may take a long time to cure you.

Your eyes may be failing. If they are the doctor will tell you and can fix them up before they get very bad. You might have a tiny bit of consumption and not know it. The doctor will find out and you can begin to treat it before it is too late. If the doctor doesn't find anything the matter with you, you will feel good in knowing that you are starting to work right.

WORKMEN, TAKE CARE OF YOUR HEALTH.

Look out for consumption, pneumonia, coughs, colds, and rheumatism.

Did you ever cough and spit up black stuff after a day's turn? That is dirt, soot, and dust that you have breathed in. Do you think that is good for the lungs? No. Do you know that one out of every seven workingmen die of consumption? Consumption is caused by a germ, and it grows best in lungs that have been breathing lots of dust and bad air. If you work in the dolomite

shed, mixing house, at an emery wheel, or in any very dusty place, keep the dust out of the lungs by wearing a respirator. Then go home, put a teaspoonful of salt in a glass of water, and wash out your mouth and nose and gargle your throat with the salt water.

Don't cool off too quickly after a hot turn. Slip on a coat or extra shirt; don't sit in a strong draft. Cool off slowly. If you don't you may get a cough or stiff joints and muscles. You will feel better, and your next turn won't feel so hot. Pneumonia is caused by a germ and is brought on very often when a person gets chilled, or when he cools off too quickly or allows his feet to stay wet and cold. When you have pneumonia your lungs get solid and you can't get air into them.

If you get stiff joints and muscles you can't do your work right and you may lose time.

Don't let your feet stay wet.

Don't put on working clothes that are damp from sweat.

Protect your body.

WATCH YOUR TEETH.

Your stomach has no teeth. If you don't chew your food before you swallow it you make your stomach do work that it isn't made for. It may do it for a time, but sooner or later it will go on a strike. Then you will have stomach trouble. You can't chew your food unless you have good teeth. Take a look at your teeth. How many need repairs? Go to a man who repairs them. A little attention now may save a tooth that otherwise will be lost in a month or two. Keep your teeth in good condition. Do you know what makes teeth decay? Much decay is caused by allowing small pieces of food to stick in and around the teeth and by allowing germs to stay there by not cleaning the teeth well. Get a toothbrush and clean your teeth well every day.

Give your stomach a chance.

Before you eat wash your hands and face. Don't eat dirt. Sit down, make yourself comfortable, take your time, and chew your food well. Eat slowly; your stomach will do better work if it is not speeded up. Don't drink too much water when you are eating. Don't drink a lot of cold water at once; it chills the stomach and may cause cramps. Drink a little water at a time and drink many times. Don't drink water that is too cold.

DON'T GO HOME DIRTY.

Don't leave the mill at the end of your turn with dirty hands and face or in your working clothes. When you quit work wash up, and put clean street clothes on. Don't think that you haven't time, for you will do it at home, and it will take no longer to do it at the mill than it will at home. You will feel better and look better. When you come to work put your street clothes into your locker. Put on your working clothes and change again when your day's duty is done.

Take a good shower bath and shampoo. It will knock out that tired feeling. Keep a clean towel and some soap in your locker. A small brush and some mechanics' soap will take that dirt off your hands. Those wash basins and showers have been put there for your use. Show your appreciation by using them and taking care of them.

WATCH YOUR FEET.

Do your feet ache and burn or smart? Have you large callouses on the bottoms of your feet? If you have, it may be because your shoes don't fit. They may be too big, too small, or of bad shape. Get shoes that fit you. Have one pair to work in and one pair to wear on the street. Street shoes were not made to work in and working shoes were not made to wear on the street. Wash your feet well every day in warm water and soap, and then bathe them in cool water and rub them well. Sprinkle a little talcum powder in your shoes. Don't wear socks that have large seams or holes in them. They rub the feet. If your feet hurt you very much see the doctor, and he will tell you what to do to fix them up.

The following might be posted in the closets:

MEN.

The water closets and urinals have been built for your use. They cost a lot of money. Use them and take care of them. Don't mark or scratch them up. Don't spit or throw paper on the floor and see that the other fellow doesn't do it.

CUT OUT THE BOOZE.

Here's what booze has done for thousands of men and may do for you:

Caused liver trouble and stomach trouble, ruined the kidneys, and spoiled digestion. It has caused hardening of the arteries and led to apoplexy and sudden death. It has dulled the brain and has caused accidents.

If you want to be a good man on your job, be liked by your boss and get promoted, cut it out. Save that money and buy something useful for your family.

PUBLICATIONS ON MINE ACCIDENTS AND METHODS OF METAL MINING.

Limited editions of the following Bureau of Mines publications are temporarily available for free distribution. Requests for all publications can not be granted, and applicants should select only those publications that are of especial interest to them. All requests for publications should be addressed to the Director, Bureau of Mines, Washington, D. C.

BULLETIN 62. National mine-rescue and first-aid conference, Pittsburgh, Pa., September 23–26, 1912, by H. M. Wilson. 1913. 74 pp.

BULLETIN 75. Rules and regulations for metal mines, by W. R. Ingalls, James Douglas, J. R. Finley, J. Parke Channing, and John Hays Hammond. 1915. 296 pp., 1 fig.

BULLETIN 80. A primer on explosives for metal miners and quarrymen, by C. E. Munroe and Clarence Hall. 1915. 125 pp., 15 pls., 17 figs.

BULLETIN 101. Abstracts of current decisions on mines and mining, October, 1914, to April, 1915, by J. W. Thompson. 1915. 138 pp.

BULLETIN 113. Abstracts of current decisions on mines and mining, reported from May to September, 1915, by J. W. Thompson. 1916. 124 pp.

TECHNICAL PAPER 4. The electrical section of the Bureau of Mines, its purpose and equipment, by H. H. Clark. 1911. 12 pp.

TECHNICAL PAPER 6. The rate of burning of fuse as influenced by temperature and pressure, by W. O. Snelling and W. C. Cope. 1912. 28 pp.

TECHNICAL PAPER 7. Investigations of fuse and miners' squibs, by Clarence Hall and S. P. Howell. 1912. 19 pp.

TECHNICAL PAPER 11. The use of mice and birds for detecting carbon monoxide after mine fires and explosions, by G. A. Burrell. 1912. 15 pp.

TECHNICAL PAPER 13. Gas analysis as an aid in fighting mine fires, by G. A. Burrell and F. M. Seibert. 1912. 16 pp., 1 fig.

TECHNICAL PAPER 15. An electrolytic method of preventing corrosion of iron and steel, by J. K. Clement and L. V. Walker. 1913. 19 pp., 10 figs.

TECHNICAL PAPER 17. The effect of stemming on the efficiency of explosives, by W. O. Snelling and Clarence Hall. 1912. 20 pp., 11 figs.

TECHNICAL PAPER 18. Magazines and thaw houses for explosives, by Clarence Hall and S. P. Howell. 1912. 34 pp., 1 pl., 5 figs.

TECHNICAL PAPER 19. The factor of safety in mine electrical installations, by H. H. Clark. 1912. 14 pp.

TECHNICAL PAPER 22. Electrical symbols for mine maps, by H. H. Clark. 1912. 11 pp., 8 figs.

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TECHNICAL PAPER 30. Mine accident prevention at Lake Superior iron mines, by D. E. Woodbridge. 1913. 38 pp., 9 figs.

TECHNICAL PAPER 40. Metal-mine accidents in the United States during the calendar year 1911, compiled by A. H. Fay. 1913. 54 pp.

TECHNICAL PAPER 46. Quarry accidents in the United States during the calendar year 1911, compiled by A. H. Fay. 1913. 32 pp.

TECHNICAL PAPER 47. Portable electric mine lamps, by H. H. Clark. 1913. 13 pp.

TECHNICAL PAPER 58. The action of acid mine water on the insulation of electric conductors; a preliminary report, by H. H. Clark and L. C. Ilsley. 1913. 26 pp., 1 fig.

TECHNICAL PAPER 59. Fires in Lake Superior iron mines, by Edwin Higgins. 1913. 34 pp., 2 pls.

TECHNICAL PAPER 61. Metal-mine accidents in the United States during the calendar year 1912, compiled by A. H. Fay. 1913. 76 pp., 1 fig.

TECHNICAL PAPER 62. Relative effects of carbon monoxide on small animals, by G. A. Burrell, F. M. Seibert, and I. W. Robertson. 1914. 23 pp.

TECHNICAL PAPER 67. Mine signboards, by Edwin Higgins and Edward Steidle. 1913. 15 pp., 1 pl., 4 figs.

TECHNICAL PAPER 77. Report of the Committee on Resuscitation from Mine Gases, by W. B. Cannon, G. W. Crile, Joseph Erlanger, Yandell Henderson, and S. J. Meltzer. 1914. 36 pp., 4 figs.

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MINERS' CIRCULAR 5. Electrical accidents in mines, their causes and prevention, by H. H. Clark, W. D. Roberts, L. C. Ilsley, and H. F. Randolph. 1911. 10 pp., 3 pls.

MINERS' CIRCULAR 8. First-aid instructions for miners, by M. W. Glasgow, W. A. Raudenbush, and C. O. Roberts. 1913. 67 pp., 51 figs.

MINERS' CIRCULAR 10. Mine fires and how to fight them, by J. W. Paul. 1912. 14 pp.

MINERS' CIRCULAR 13. Safety in tunneling, by D. W. Brunton and J. A. Davis. 1913. 19 pp.

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MINERS' CIRCULAR 17. Accidents from falls of rock or ore, by Edwin Higgins. 1914. 15 pp., 8 figs.

MINERS' CIRCULAR 20. How a miner can avoid some dangerous diseases, by A. J. Lanza and J. H. White. 1916. 26 pp., 4 figs.

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